National Aeronautics and
Space Administration

technology solution

Sensors

Real-Time Interferometric Fiber Optic Bragg Grating Sensors

High sensor count distributed fiber optic sensing without processing delays

NASA's Langley Research Center has demonstrated a powerful technique for real-time fiber optic sensing. This patent pending technology combines a compact in-fiber interferometric network with distributed fiber optic Bragg grating sensors to enable real-time physical monitoring with high accuracy and resolution. The technology offers the ability to simultaneously measure hundreds of discreet fiber sensors without the need for slow and complex data processing. NASA developed the technology to enable real-time monitoring of structural and environmental conditions for vehicle health monitoring. The versatility of this technique offers broad utility in applications where high sensor counts and real-time monitoring of physical parameters are required.

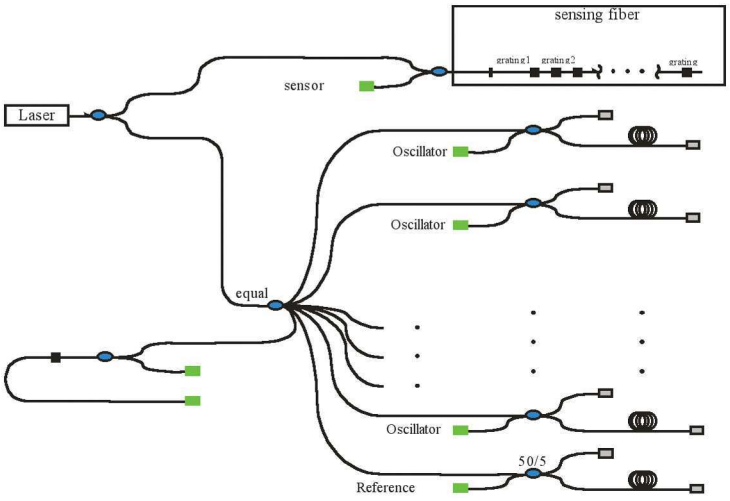
BENEFITS

- Real-time distributed sensing of strain, temperature, pressure, and chemical presence
- High sensor counts (hundreds) with high spatial resolution (separation) not possible with wavelength division multiplexing techniques
- Requires no digital signal processing (DSP) overhead, virtually eliminating measurement delay
- Eliminates the need for complex algorithm sampling and analog-to-digital conversion of data
- Fiber optic platform enables intrinsically safe operation for integrated and embedded sensing

THE TECHNOLOGY

The use of fiber optic-based sensors has enabled robust, low-cost, intrinsically safe measurement of physical parameters like stress, temperature, pressure, and the presence of certain chemicals. Fiber optic sensors can be used for single point detection or, in the case of Bragg grating sensors that are written along the length of a fiber, distributed sensing for large area monitoring. However, the use of distributed Bragg grating sensors usually involves a compromise between the highly desirable characteristics of fast data acquisition, high sensor counts, and high resolution. The new NASA Real-Time Interferometric Fiber Optic Bragg Grating Sensor technology eliminates that compromise.

The new NASA system modifies existing NASA Optical Frequency Domain Reflectometry technology (NASA patents US#5,798,521 and US#6,566,648) to eliminate the need for massive data storage, complex algorithm manipulation, and the inherent limitations tied to processor speeds. By constructing a location-matched oscillator to each discrete sensor grating, each Bragg grating spectra can be demodulated and peak-detected without the need for complex digital processing. The resulting system allows hundreds of distributed sensors to be interrogated in real time, which is essential for immediate event detection in safety-critical systems.



Real-Time Interferometric Fiber Optic System Architecture

APPLICATIONS

The technology has several potential applications:

- Aerospace - vehicle health monitoring (e.g., wing, fuselage)
- Civil transportation - structural (e.g., bridges, buildings) health monitoring
- Oil and gas industry - down-well sensing, structural monitoring
- Industrial - multi-parameter physical sensing and health monitoring
- Medical - real-time tactical feedback systems

PUBLICATIONS

Patent No: 7,538,860

More Information

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NP-2014-09-1185-HQ

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LAR-17300-1